



September 14, 2009

Wesley D. Grimes, P.E.
Charles P. Dickerson
Jonathan A. Balasa, E.I.T.
Jack L. Richardson

Mr. John Merritt
Merritt & Associates, P.C.
917 North Robinson
Oklahoma City, OK 73102

Re: Raley v. Hyundai Motor Company
Your File No.: 51425
C.E.A. Case: 3708

Dear Mr. Merritt:

I have reviewed Brad Matheson's work in which he overlayed the Oklahoma State Patrol dash camera image onto the three dimensional animation scene. This work showed that the rest position of the Raley vehicle in the crash reconstruction animation was approximately 10 feet short of the position determined by the image overlay.

Since it was not possible in the crash reconstruction to precisely locate the position of the Raley vehicle when it began to rollover or where it came to rest, the 10 ft. difference is within the resolution of the reconstruction. I have requested that Mr. Matheson move the trip location 10 ft. further down the hill and retain the original rollover motion. This will place the rest position 10 ft. beyond its original location.

Please do not hesitate to contact me if you have any questions.

Sincerely,

COLLISION ENGINEERING ASSOCIATES, INC.

Charles P. Dickerson

Charles P. Dickerson

P.O. Box 31900 • Mesa, Arizona 85275-1900
1540 E. University, Suite 500 • Mesa, Arizona 85203
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EXHIBIT

6-A



Wesley D. Grimes, P.E.
Charles P. Dickerson
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September 2, 2009

John Merritt
Merritt & Associates, P.C.
917 N. Robinson
Oklahoma City, OK 73102

Re: Raley v. Hyundai
C.E.A. Case 3708

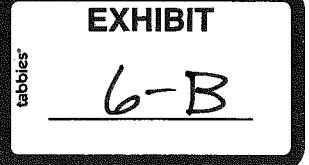
Dear Mr. Merritt:

In a previous letter report dated September 11, 2007, I presented observations concerning evidence of impacts to the underside of the Raley vehicle. On October 28, 2008, I had the opportunity to further inspect the underside of the Raley vehicle. Additional evidence of undercarriage impact was observed.

Figures 1 through 4 are photographs of the underside of the right front aspect of the Raley vehicle. In the figures all of the photographs are oriented such that the vehicle is pointed to the right.

Figure 1 shows the underside of the right front of the Raley vehicle. Figures 2 through 4 are closer views of the sub-frame that is visible in figure 1. Figure 2 is a portion of the sub-frame that is slightly rearward of the portion that is visible in figure 3. Figure 4 is a closer view of the central region of figure 3.

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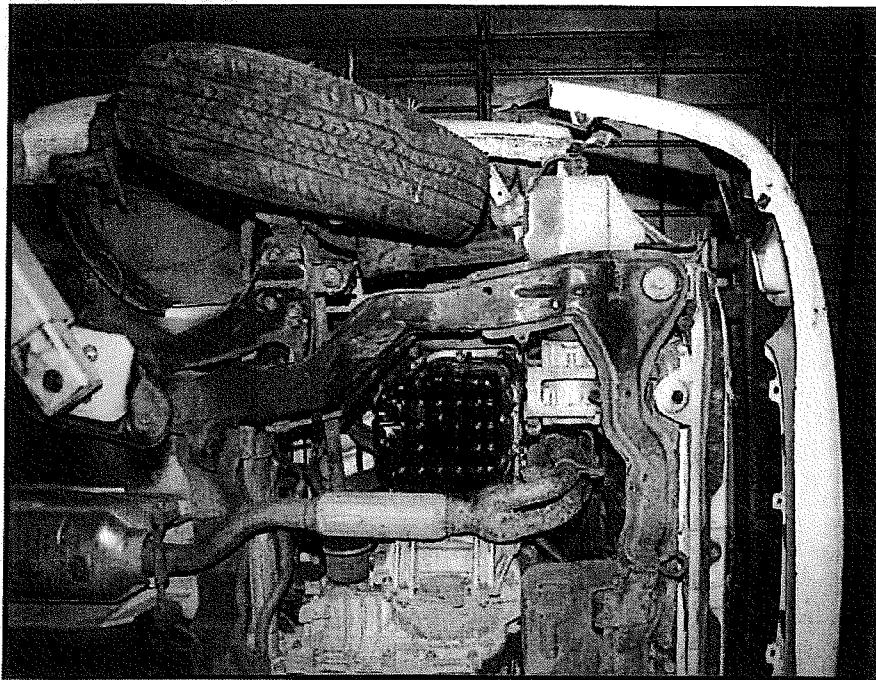


Figure 1. Underside of right front of the Raley vehicle.

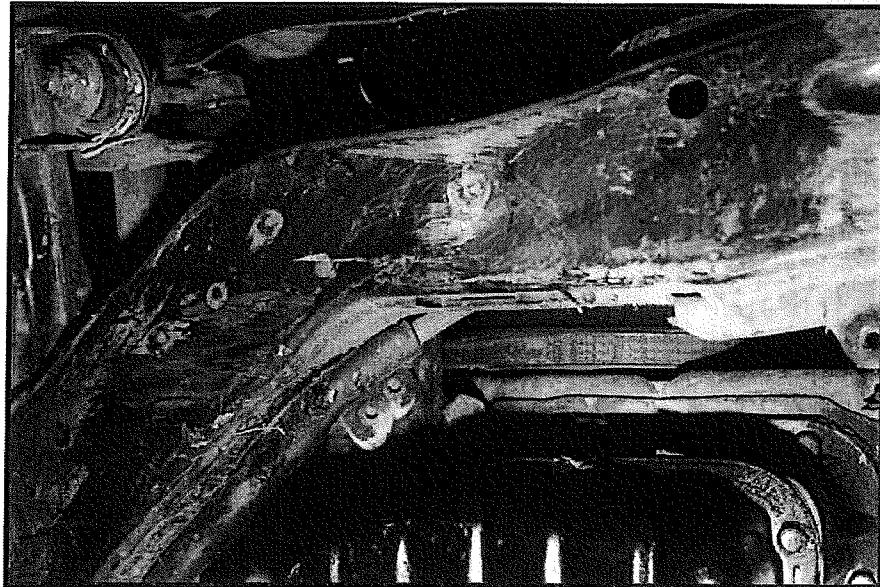


Figure 2. Underside of sub-frame.

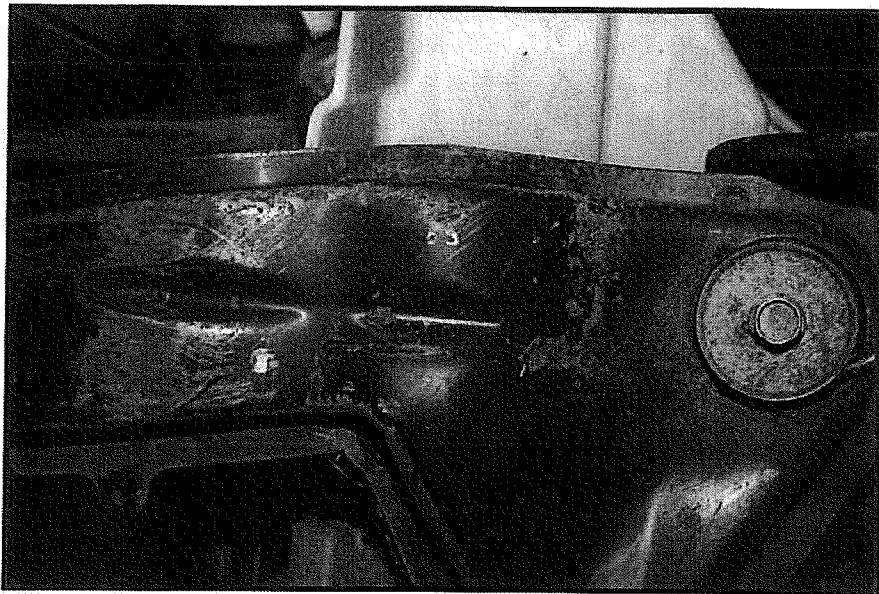


Figure 3. Underside of sub-frame forward of Figure 2.



Figure 4. Close-up of central region of Figure 3.

Two families of marks were visible on the underside of the sub-frame. The longitudinally aligned set (horizontal in the photographs) was comprised of deep scratches that penetrated the paint and disturbed the surface of the metal. These marks were not made by contact with a soft surface such as the road shoulder.

The second family of marks was faint and oriented more laterally to the vehicle. In the figures the marks are about 60 degrees counterclockwise from horizontal. In most areas the marks did not penetrate the paint.

The nature of the second set of marks was consistent with contact with the grass surface of the shoulder where the Raley vehicle rolled over. The orientation of the marks indicated that the vehicle was in a passenger side leading yaw when the marks were made. This was consistent with the orientation of the Raley vehicle at the termination of the first revolution of the rollover.

The second set of marks probably resulted from an undercarriage to ground impact as the Raley vehicle was finishing the first revolution of its two revolution rollover.

If you have any questions, please do not hesitate to contact me.

Sincerely,

COLLISION ENGINEERING ASSOCIATES, INC.



Charles P. Dickerson



COLLISION

ENGINEERING ASSOCIATES, INC.

Wesley D. Grimes, P.E.
Charles P. Dickerson
Jack L. Richardson
Jonathan A. Balasa
Eric J. Hunter

September 11, 2007

John Merritt
Merritt & Associates, P.C.
917 N. Robinson
Oklahoma City, OK 73102

**RE: Raley v. Hyundai
C.E.A. Case 3708**

Dear Mr. Merritt:

Per your request, I inspected the undercarriage of the Raley vehicle on August 31, 2007. Additional observations and conclusions from that inspection are as follows:

Both lower control arms on the rear suspension were deformed. The forward face of the left control arm was buckled rearward in the middle region and the bottom of the left control arm was scraped. The right rear lower control arm was also deformed. The forward face was deformed rearward near the connection to the spindle at the outboard end of the link.

The damage to the rear lower control arms was probably due to post-crash handling. Storage facilities typically use fork lifts that are equipped with long forks for lifting vehicles from the front or back. When the forks are slid under the vehicle the damage described above can occur.

No gross deformation or damage to the front suspension components was observed.

There was evidence of a vertically aligned impact to the underside of the right rear of the vehicle. The muffler had been in contact with the body structures that were above and to the left of the muffler. Faint laterally aligned abrasions were visible on the underside of the muffler. Damage to the underside of the rocker panel forward of the right rear wheel was also observed and there was evidence that the right rear tire had been in contact with the inner fender panel above and forward of the right rear wheel.

There was lateral crazing of the paint on the right rear lower aspect of the rear bumper cover. The sheet metal bumper attachment on the right rear portion of the bumper cover was also deformed consistent with a vertical displacement of the right aspect of the rear bumper cover.

EXHIBIT

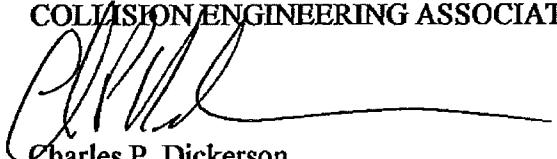
tabbies®

6-C

If you have any questions, please do not hesitate to contact me.

Sincerely,

COLLISION ENGINEERING ASSOCIATES, INC.

A handwritten signature in black ink, appearing to read "C.P. DICKERSON".

Charles P. Dickerson



COLLISION

ENGINEERING ASSOCIATES, INC.

Wesley D. Grimes, P.E.
Charles P. Dickerson
Jack L. Richardson
Jonathan A. Balasa
Eric J. Hunter

August 9, 2007

Mr. John Merritt
Merritt & Associates, P.C.
917 N. Robinson
Oklahoma City, Oklahoma, 73102

**RE: Raley v. Hyundai
C.E.A. Case 3708**

Dear Mr. Merritt:

I have been advised by Lee DeChant that after his further review of his photogrammetric study, the results may or may not reliably depict the correct location of items shown in the Oklahoma Highway Patrol dash cameras. I had relied upon the accuracy of Mr. DeChant's analysis to make modifications to my original crash reconstruction.

My original crash reconstruction relied upon the Highway Patrol's determination of the location of the Raley vehicle after the crash. The modifications I then made to my reconstruction were based on the rest position of the Raley vehicle as depicted in the photogrammetric study.

Since the photogrammetric study does not appear to be reliable, I now return to my original opinions concerning the crash reconstruction as presented in my first deposition on December 5, 2006, which were based on the best information available as to the rest position of the Raley vehicle as described by the Oklahoma Highway Patrol.

At the time that I made my modifications based on the photogrammetric study, I noticed an error in my original crash reconstruction. The probable path of travel of the Raley vehicle as presented in my original reconstruction would have resulted in the Raley vehicle striking the highway barrels on the left side of the northbound lanes. This was corrected in the modifications that were presented in my second deposition.

Attached is a revised scale drawing illustrating my opinions concerning the path traveled by the Raley vehicle. In it the probable path that the Raley vehicle followed has been modified such that the vehicle avoids the left side highway barrels. My opinions concerning the rollover are my original opinions as presented in my December 5, 2006 deposition.

EXHIBIT

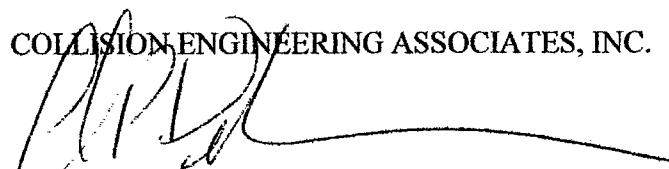
tables

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If you have any questions, please do not hesitate to contact me.

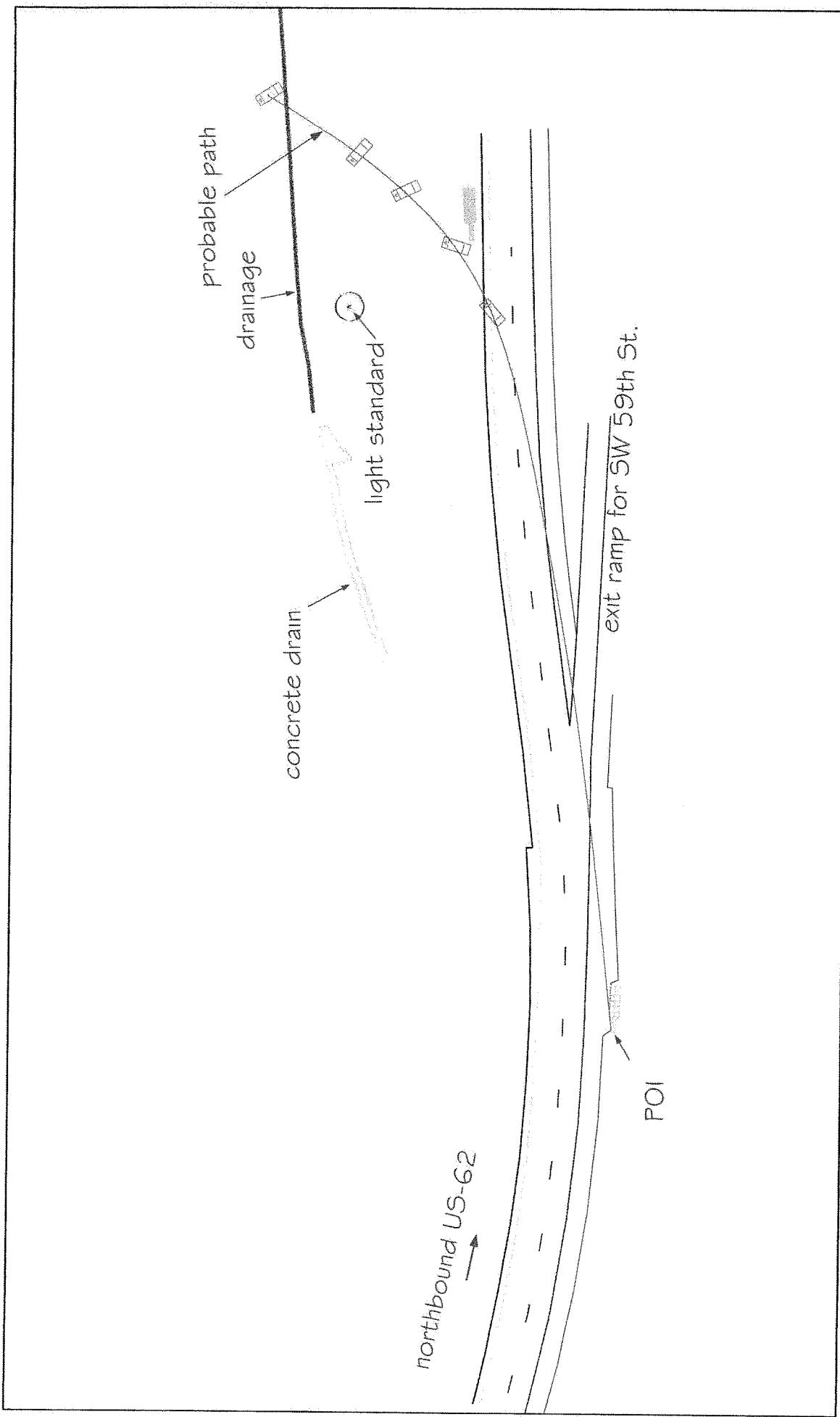
Sincerely,

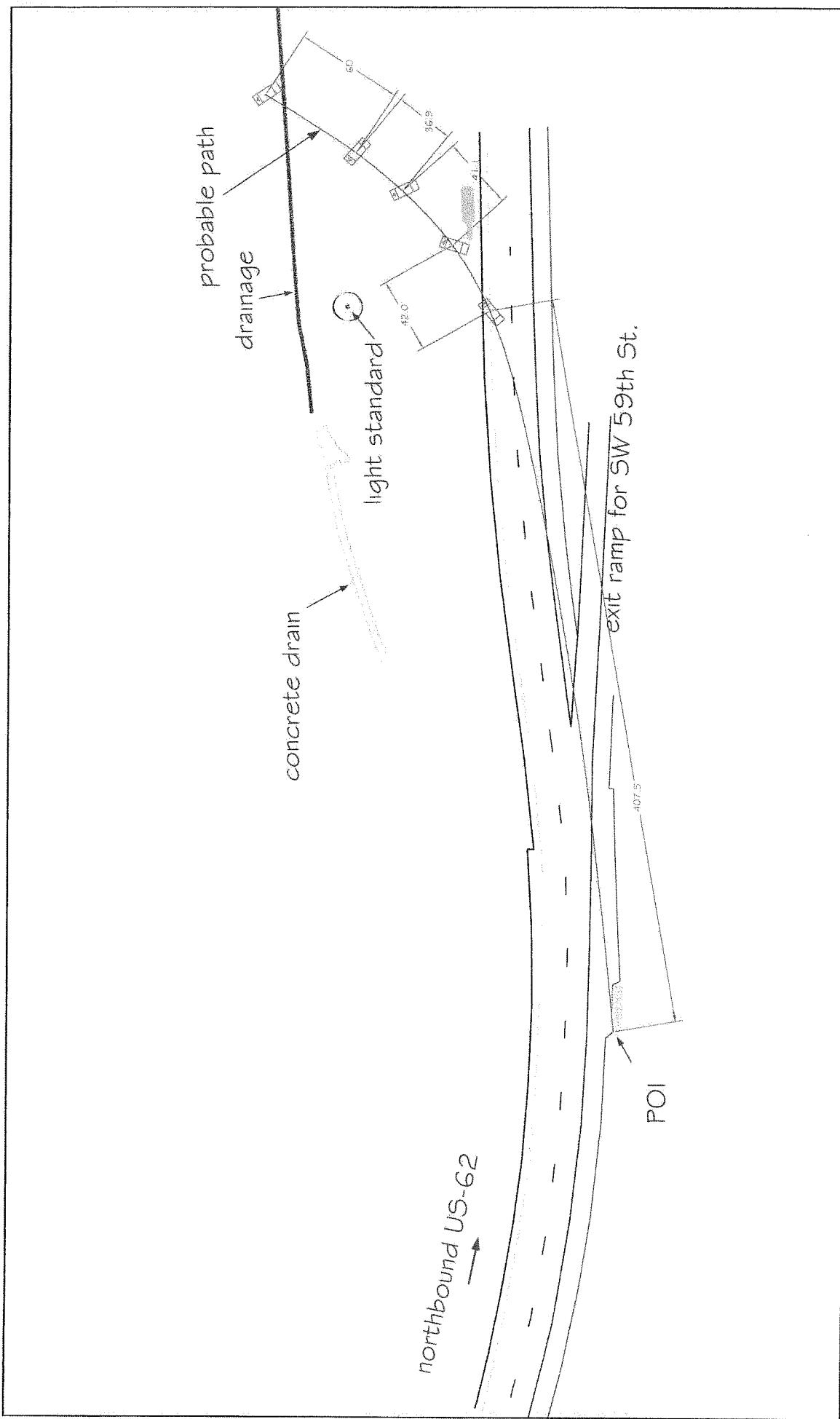
COLLISION ENGINEERING ASSOCIATES, INC.



Charles P. Dickerson

Enc.







Wesley D. Grimes, P.E.
Charles P. Dickerson
Jack L. Richardson
Jonathan A. Balasa
Eric J. Hunter

PRELIMINARY

CRASH RECONSTRUCTION REPORT

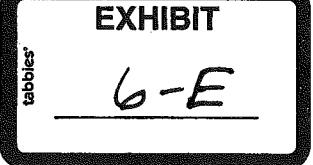
Raley v. Hyundai
September 29, 2006

prepared by:

Charles Dickerson

PRELIMINARY

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INTRODUCTION

The crash at issue occurred on December 19, 2003 at approximately 9:40 pm on northbound U.S. Highway 62 in Oklahoma City, Oklahoma. A 1999 Hyundai Sonata, operated by Ms. Misty Raley, moved onto the right shoulder and struck several highway barrels then exited the left edge of the highway. It subsequently rolled over as it traveled down an embankment before coming to rest. Ms. Raley was completely ejected and is a quadriplegic as a result of injuries suffered in the crash.

Ms. Raley's three children were also in the vehicle and sustained minor injuries.

Appendix A contains all of the figures referred to in the sequel. Appendix B contains a copy of the author's curriculum vitae.

MATERIAL REVIEWED

The following materials were reviewed:

1. Official Oklahoma Traffic Collision Report, #AM-2652
2. Dash camera video from Trooper Matt Davidson's patrol vehicle
3. Deposition of Misty Raley, 12/7/05
4. Video taped statement of OHP Trooper Jason Lanier
5. Plaintiff's Petition
6. Color copies of photographs of the Hyundai Sonata taken by Xperts LLC
7. *Characteristics of Soil Tripped Rollovers*, SAE 980022, Cooperrider et al.
8. *Analyzing the Trip-Phase of Soft-Soil Rollovers*, SAE 2006-01-1558, Grimes et al.

In addition to the above, the Hyundai Sonata that was involved in the crash was inspected on May 10, 2006. The crash scene was inspected on May 11, 2006 and June 21, 2006. The author discussed this case with Trooper Lanier while at the scene during the June 21 inspection.

OBSERVATIONS – scene

The crash occurred on northbound US-62 in Oklahoma City Oklahoma. In this area, an east/west aligned freeway, I-240, intersected the north/south aligned I-44 from the east. At the intersection, I-240 turned north and became I-44. The crash occurred on a two lane ramp that provided a transition for northbound I-44 traffic from south of I-240 to I-44 north of I-240. Figures 1 through 5 show the nature of the road in the area of interest.

In the area where the crash occurred, the roadway was two lanes wide with a narrow concrete shoulder on the left and an emergency lane on the right. Traffic approached the scene in a gentle left turn that continued through the scene. Just north of the point of impact was an exit ramp for SW 59th St. Just south of the exit ramp along the right edge of the emergency lane was a Jersey barrier with the south end of the barrier protected by energy absorbing highway barrels. These barrels were constructed of plastic and filled with sand. The barrels are marked with a red arrow in Figures 1 and 2. Figure 3 is a view of the barrels from the north.

The shoulder along the left edge of the roadway sloped downward away from the left lane. At the bottom of the embankment was a large grass median created between the various roads that comprised the freeway interchange. The shoulder surface was mowed grass. The embankment that the Hyundai traversed is marked with a green arrow in figure 2. Figures 4 and 5 show the embankment and median.

Roughly parallel to the roadway in the grassy median, there was a drainage that fed a small concrete basin. The drainage to the south of the basin was concrete while from the north it was simply a depression in the median surface. The basin drained into a culvert that went east under the roadway.

On the side of the embankment was a 15 ft. diameter concrete pad that supported a light fixture.

At the time of the author's inspections, no evidence from the crash at issue was observed. Figure 6 is a scale drawing of the scene. Figure 7 is a scale drawing of the scene with an estimate of the path of the Hyundai. Figure 8 is a three dimensional rendering of the scene.

OBSERVATIONS – Hyundai Sonata

The vehicle involved in this crash was a 1999 Hyundai Sonata 4-door sedan. It was equipped with automatic transmission, 4 cylinder engine, electric windows, electric door locks, electric mirrors, cruise control, glass panel sun roof, driver and front passenger front air bags and driver and front passenger side airbags. It was not equipped with antilock brakes.

Evidence from both contact with the barrels and from the rollover was apparent.

Plastic transfers and abrasions were observed along most of the right side. The barrel contact started above the right front wheel opening near its rear aspect and continued rearward to the right side of the rear bumper cover. The body panels along this path were deformed inward. Fragments of yellow plastic were observed trapped in the gap between the right front quarter panel and the right front door panel. A small fracture was noted in the right end of the plastic bumper bar. No significant longitudinal deformation of the bumper and frame structures was observed.

The tires and wheels appeared to have been in good condition prior to the crash.

Since the rollover occurred on a relatively smooth grass surface, the resulting abrasions were difficult to detect and photograph. None of the abrasions penetrated the paint on the body panels.

The abrasion directions were marked on the vehicle with red arrows in which the direction of the arrowhead was arbitrary. Figures 9 through 16 are photographs of the Hyundai. Figure 17 is a drawing showing the general location and orientation of the observed abrasions.

Two distinct directions of abrasion were observed. A possible third direction was also observed. The first and most significant direction ran roughly 70 degrees from the longitudinal axis of the vehicle and was observed on the hood, left front quarter panel, left front aspect of the roof, back of left front door, left rear door above the trim line and the left rear quarter panel. The abrasions in these areas were straight and relatively uniform. This abrasion set is depicted in red in figure 17.

The second significant abrasion set was confined to the left front aspect of the hood and was aligned approximately 30 degrees left of the longitudinal axis. These marks were not as straight and uniform as the previously mentioned set. They also had a layer of muddy water residue associated with them. This abrasion set is depicted in blue in figure 17.

The third set of marks was quite faint and consisted of short shallow abrasions on the right edge of the roof. These were aligned vertically and found above the right rear door and at the top of the right A-pillar. This abrasion set is depicted in green in figure 17.

Rollover related impacts were evident to the right front hood and quarter panel. The left side of the hood, left side of the roof and left C-pillar were also impacted and deformed. The roof above the driver's seating position was deformed downward such that the top of the B-pillar was in contact with the top of the driver's seat back. The top of the left A-pillar was just above the upper aspect of the steering wheel.

Mud and grass was found imbedded in the right front wheel, at the base of the right A-pillar and in cracks in the right end of the front bumper.

DISCUSSION AND ANALYSIS

Very little documentation of this crash was provided by the Highway Patrol. No photographs were taken and two measurements were collected.

The police report stated that the vehicle came to rest 620 ft. north of the point of impact and that it traveled 180 ft. on the shoulder. Discussion with Trooper Lanier revealed that the measurements were taken along the vehicle's traveled path. The point of impact (POI) was the southwest aspect of the most southern barrel (first point of contact) and the distance traveled on the left side median was probably measured along the path starting at the yellow fogline.

He remembered observing furrows in the grass surface but was unable to provide any details concerning their nature, length or location. He was also unable to identify the location where the Hyundai entered the median or provide any information concerning marks that may have been on the road between the median and the barrels.

The video from Trooper Matt Davidson's patrol vehicle was a view taken looking out the windshield from about the dashboard. The camera was fixed in the vehicle. As Trooper Davidson was arriving and parking at the crash scene, the area where the Hyundai

traversed the embankment passed through the view. The rest position of Hyundai was clearly visible.

If it is assumed that the roadway is oriented north/south, the Hyundai was at rest upright, pointed in a southwesterly direction.

To the right and near the front of the vehicle a white blanket and a kneeling person were visible. This was the probable rest position of Ms. Raley. This placed Ms. Raley beyond the vehicle and along its path of travel.

In the background on the side of the embankment, what appeared to be a pair of tracks was visible. These marks were difficult to discern in the video. They were consistent with wheel marks made by the Hyundai as it traveled down the embankment. The marks appeared to go to the bottom of the embankment.

The marks indicated that the Hyundai was near the bottom of the hill when it began to roll. This information and the total distance traveled off-road that the rollover distance was approximately 60 feet.

The abrasions and deformations observed on the body of the Hyundai indicated at least two unique contacts between the body and the median surface. Two distinct patterns were observed on the left front aspect of the hood indicating two contacts to this corner.

Displacement of the pin striping on the left front quarter panel and the way that mud and grass was imbedded in the right front aspect of the vehicle indicated that the vehicle rolled passenger side leading.

The first and most significant impact appears to have occurred early in the rollover sequence. The direction shown in red on figure 17 was created in the first contact after the vehicle tripped. The damage to the roof structure and left C-pillar also probably occurred in this contact. At this time the vehicle had completed the first 180 to 270 degrees of the roll sequence.

In the second revolution, the vehicle contacted the left front corner and the right front corner. The residue associated with these marks suggested that when these marks were made, the vehicle was near the bottom of the hill where water was more likely to collect.

The third set of abrasion shown in figure 17 (green) probably occurred during the first roll. While the abrasions and contacts would support the possibility of a third roll, it is highly unlikely that three rolls were possible given the relatively short rollover distance.

The orientation of the first set of abrasions (red in figure 17) suggested that the vehicle was in a passenger side leading slide with a slip angle of roughly 70 degrees when it began to roll over.

Calculation of speed at the beginning of the rollover and at the road edge was performed assuming a total travel distance of the 180 ft.

An elevation change of approximately 21 ft. was measured from the road edge down to the estimated point of rest (POR). Along the path the slope was approximately 10 degrees downhill.

Tests in the literature (Cooperrider, 1998) indicated that the lateral acceleration developed in soft soil was significantly higher than that generated by a tire on a paved surface. These tests also showed that a test vehicle (an Oldsmobile sedan) that entered the soil at a high slip angle at 43 mph traveled roughly 35 feet before the beginning of the rollover.

For the crash at issue it was assumed that the Hyundai traveled 120 feet on the shoulder before the beginning of the rollover sequence. For 35 feet of this distance a drag factor of 1.2 was used. A drag factor range of 0.3 to 0.5 was used for the remaining 85 feet. A drag factor range of 0.4 to 0.5 was then used for the rollover portion of the path. The loss of elevation was accounted for in the calculations.

The speed at the beginning of the roll sequence was between 25 and 29 mph. The speed at the road edge was 46 to 53 mph.

The speed at the contact with the barrels was not calculated. Little evidence exists to allow determination of details concerning the path of the Hyundai between the barrels and the road edge.

No significant structural deformation was associated with the barrel contact. The impact was also not severe enough to deploy the frontal airbags.

CONCLUSIONS AND OPINIONS

The opinions and conclusions presented below are based on the information available and the work completed at the time of this report. Should more information become available, it will be necessary to review it and determine if more work is warranted and if modification of the opinions and conclusions is necessary.

- The 1999 Hyundai Sonata exited the left edge of US-62 in a passenger side leading slide traveling 46 to 53 mph.
- The body slip angle when the Hyundai began to roll was approximately 70 degrees.
- The Hyundai rolled passenger side leading.
- At the beginning of the rollover the Hyundai was traveling 25 to 29 mph.
- The Hyundai completed two revolutions before coming to rest.

Respectfully Submitted,



Charles P. Dickerson
COLLISION ENGINEERING ASSOCIATES, INC.